Anatomy structure features extraction in the process of large across compressive deformation of wood[1)]

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Abstract In this study "the leftest trace algorithm " was used to solve the trace of cells edge better. It also overcame the shortage that use sobel operator and laplace operator to detect the edge of wood cells. This realized the rapid extraction of the anatologic shape features in across compression and make possible the wood species could be characterized quantitatively.

Keywords: Computer vision, Across compression, Image process, Detection of objective edges.

Introduction

Recently, with the emergence of new soften technique of wood, the worldwide research in large across compressive deformation and figuration disposition is developed rapidly, but there is still few research in dynamic process of across compression. Especially, the research of deformation pattern in analogy structural and the impact of micro structural features' change on wood properties is fewer than it. Therefore, the extraction of modality parameter of wood structural features is key to achieve this aim. It also provides scientific basis for reasonable processing and utilization of the hard wood.

Material and methods

Wood samples of *Picea koraiensis* Nakai were used in this study. The samples were taken from Jinshantun, Yichun forest region in Northeast district. The radial pressure was loaded on the samples, which dimension was 15 mm (R) × 10 mm (T) × 20 mm (L).The samples were soaked in distilled water and the transverse surfaces were made smoothly using a microtome. Specimens were dried slowly to avoid collapse and made into air-dried wood. The compression experiment used the mechanical testing machine as the compressing device. The velocity of compressive deformation is 1.0~2.0 mm/min. Samples were preparedly placed in jig to prevent from relapsing when pressure was unloaded. The sample can be taken out to see the deformation of the section's structure features at the same time.

In order to analyze the deformation rule of structure features of *Picea koraiensis* in compression processing, shape feature parameters of wood are extracted. First, we used metallogic microscope to take clear pictures of cells, and then transformed cells image into digital image by CCD camera and V512A image processing chip, and used technology such as Media filter, gray transform, image segment to get a clear picture.

Cell edge detection

The shape feature of cells is the important basis for recognizing the wood and knowing its properties. With the development of computer technique and pattern recognition, the description to shape features has been changed from qualitative analysis into quantitative analysis. Exact detection of cell edge is one of the most important steps in wood micro analysis.

"The leftest trace algorithm " in this study solved the trace and scan of cells edge better. It also overcomes the shortage of using sobel operators and laplace operator to detect the edge of wood cells. The main idea of algorithm is to determine the image searching order through the Freeman chained code, adopt the line-by-line scanning mode, from up to down, from left to right, tracking the objective edge point (the gray valve is 1). Finally, the edge of the whole cell is described by the Freeman chained code. Flow chart of the algorithm was shown in Fig. 1.

In the process of wood compression, the convexo-concave deformation of cells can be used in quantitative analysis to describe the compressive effect on lumen and deformation of cell cavity and cell wall. The deformation includes the concavity, convexity, average convex/concave distance, largest convex/concave distance and convexo-concave ratio of cell edge, etc. The pattern feature of convexo-concave of cell edge can be used to distinguish the cell's convexity and concavity. Firstly, we took the advantage of the convexity, concavity and convexo-concave ratio to judge the cell edge and give the

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pattern classification (such as completely convex, completely concave, generally convex, generally concave, convex and concave). Then, we used the average and maximal convexo / concave distance to judge the smoothness and convexo-concave of cell edge. To use the upper edge of wood cells as the example, the concrete flow diagram was shown in Fig. 2.

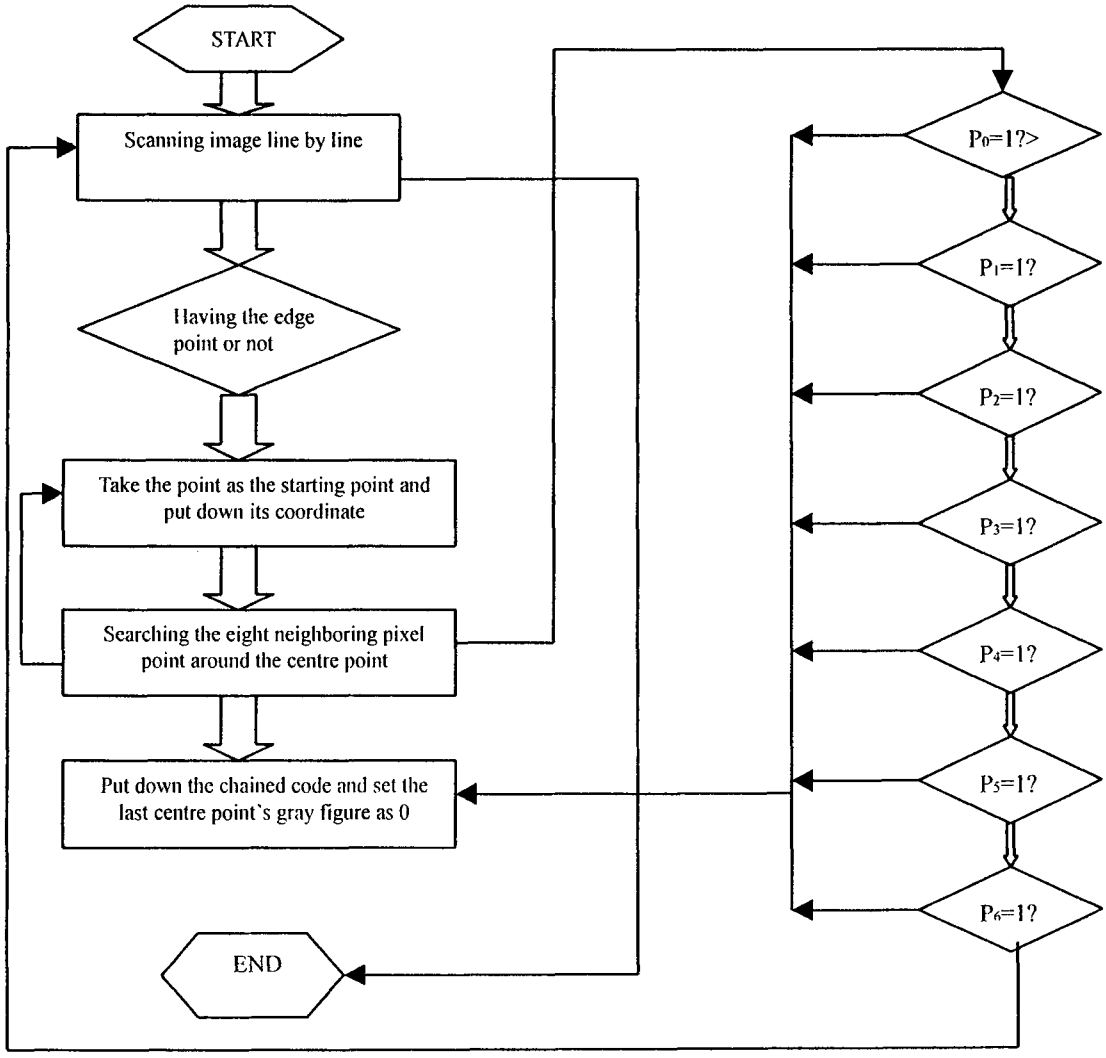

Fig. 1. Flow chart of "the leftest edge traced algorithm"

Cells shape features extraction

Description of two-dimension shape features, such as the area, the perimeter, circularity (compactness), maximal diameter, etc are the essential method in micro modality analysis area. They can be described in two ways. One is called border features that use objective border features (border length, curvature, etc.) to describe the object's shape features; The other is called region features that use the area covered in image by the object to describe the shape features (such as area, moment, etc).

To solve the cells shape features problem, this study gives the quantitative analysis to cell shape by using 13 shape features to describe and recognize the cell structure. In these shape features, 7 of them are border features and the others are regional features. Fig. 3 shows the extraction and calculation flow chart of cells shape features.

Conclusion

The extraction of anatomical features parameter in across compression gives an important theoretical basis for the principle in across compression. The pattern features that describe the anatomical shape features give the quantitative analysis to microstructure deformation. The analysis system can be used to extract the shape feature parameters of wood and makes it possible that wood species can be analyzed quantitatively.

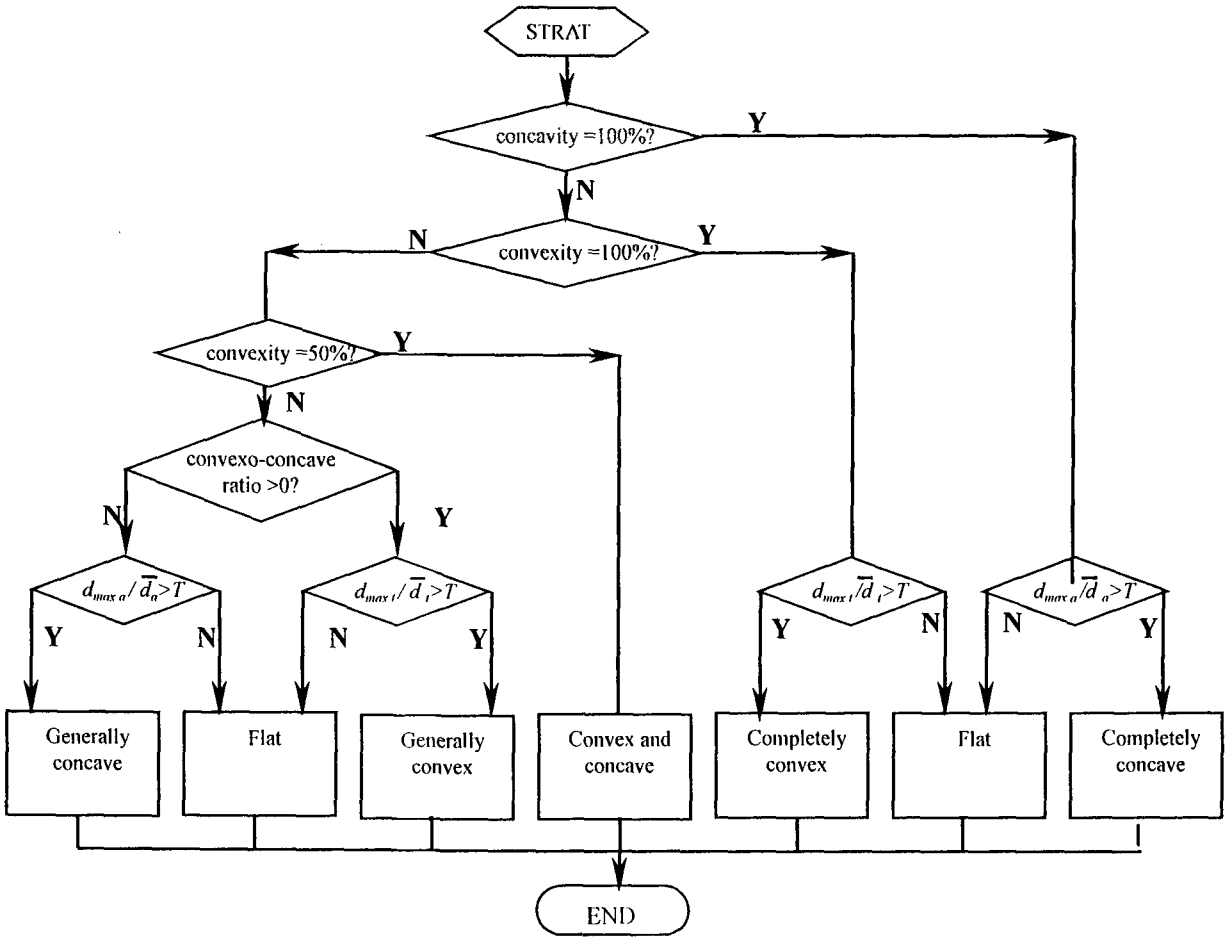

Fig. 2. Flow chart of distinguish cell convexo-concave

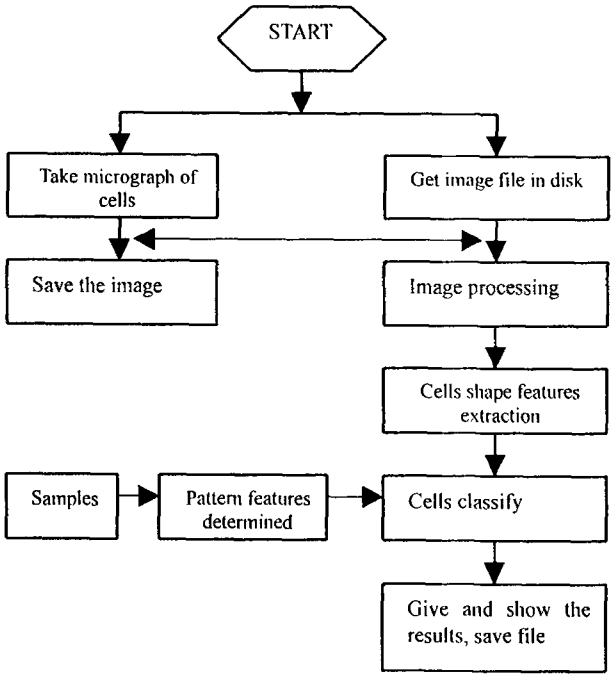

Fig. 3. Flow chart of wood modality features extraction

Reference

Diao Xueming, *et al.* 1997. Quantitative morphological evaluation of cross-sectional vessel shapes in hardwoods using image processing. Mokuzai Gakkaishi **43**(9): 709-716

Liu Yixing, *et al.* 1995. Quantitatively Analysis To Relationship Between strain and stress in across large compressive deformation process, Forestry Science, **31**(5): 436-441

Poulsen, J. S. *et al.* 1997. Kink band initiation and band broadening in clear wood under compressive loading. Mech. Mat., **25**: 67-77

Wang Jinman *et al.* 1994. Gluing shaving board computer vision analysis. Journal of Northeast Forestry University, **22**(3): 95-99(1994).

Xiuming DiAo. *et al.* 1996. Analysis of Cell Arrangements in Softwoods using Two-Dimensional Fast Fourier Transform. Wood Science Magzine, **42**(7)

1.Xiuming DiAo *et.al.* 1996. Quantitative Morphological Evaluation of Cross-sectional Vessel Shapes in Hardwoods using Image Processing. Wood Science Magzine, **42**(9)